CENTRAL MAINE COASTAL BASIN
UNION, MAINE

SENNEBEC POND DAM
ME 00248

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

APRIL 1981

407-102

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:
NEDED

SEP 1 1981

Honorable Joseph E. Brennan
Governor of the State of Maine
State Capitol
Augusta, Maine 04330

Dear Governor Brennan:

Inclosed is a copy of the Sennebec Pond Dam (ME-00248) Phase I Inspection Report, prepared under the National Program for Inspection of Non-Federal Dams. This report is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. I approve the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is vitally important.

Copies of this report have been forwarded to the Department of Agriculture and to the owner, Sennebec Association, Union, Maine. Copies will be available to the public in thirty days.

I wish to thank you and the Department of Agriculture for your cooperation in in this program.

Sincerely,

C. E. Edgar III

Incl
As stated

C. E. EDGAR, III
Colonel, Corps of Engineers
Commander and Division Engineer

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

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Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

DAMS, INSPECTION, DAM SAFETY,

Central Maine Coastal Basin
Union, Maine
St. George River

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The dam is a concrete gravity structure. The dam is in fair condition, based on a visual examination of the structure. It is intermediate in size with a hazard potential of significant. The dam is in fair condition. There were come deficiencies noted, there was no evidence of settlement, lateral movement or other signs of structural failure, or other conditions which would warrent remedial attention.

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CENTRAL MAINE COASTAL BASIN
UNION, MAINE

[SENNEBEC POND DAM, Union...]
ME 00248

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
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WALTHAM, MASS. 02154

APRIL 1981

NATIONAL DAM INSPECTION PROGRAM
PHASE I INVESTIGATION REPORT

Identification No.:	ME 00248
Name of Dam:	Sennebec Pond
Town:	Union
County and State:	Knox, Maine
Stream:	St. George River
Date of Site Visit:	7 November 1980

BRIEF ASSESSMENT

Sennebec Pond Dam, also known as Hills Mills Dam, is a concrete gravity structure. A single gated opening located at the right end of the dam functions as the outlet works. At the left end of the dam there are three slide gates to regulate flow into a canal that runs adjacent to the left side of the river for a distance of 1,200 ft. The center line crest length of the dam is 233 ft. The height of the dam is 18 ft. and the estimated storage at top of dam (El. 93.1 NGVD) is 10,700 acre-ft. The structure once provided water for a generating station located 700 ft. downstream from the dam. The present owner utilizes the dam to maintain the water level of Sennebec Pond for recreational purposes.

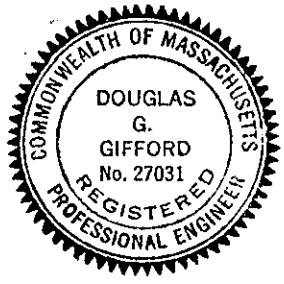
Due to the possible loss of a few lives, in the event the dam were to fail, Sennebec Pond Dam has been determined to have a "significant" hazard potential classification in accordance with Corps of Engineers guidelines.

The dam is in fair condition, based on a visual examination of the structure. Although some deficiencies were noted, there was no evidence of settlement, lateral movement or other signs of structural failure, or other conditions which would warrant urgent remedial action.

Based on the "intermediate" size and "significant" hazard potential classifications, in accordance with Corps of Engineers guidelines, the adopted test flood for this dam is 1/2 the Probable Maximum Flood (1/2 PMF). Hydraulic analyses indicate that the routed test flood outflow of 12,000 cfs (inflow 13,750 cfs or 125 csm) would overtop the dam by about 3.6 ft. With the water level at the top of dam, the ungated spillway capacity is approximately 4,400 cfs which is 37 percent of the test flood.

The Sennebec Association should engage a registered professional engineer qualified in the design and construction of dams to perform a detailed hydrologic and hydraulic investigation to assess further the need for and means to increase the project discharge capacity and the ability of the dam to withstand overtopping, as outlined in Section 7.2. Any necessary modifications resulting from the investigation and remedial measures, including repairs to the concrete, outlet works and canal intake gates, monitoring of the seepage condition, and removal of the trees adjacent to both abutments and on the ridge, as outlined in Section 7.3, should be implemented by the Owner within one year after receipt of this report. The Owner should also prepare a formal operations and maintenance manual for the dam and establish an emergency preparedness plan and downstream warning system.

HALEY & ALDRICH, INC.
by:



Douglas G. Gifford
Vice President

This Phase I Inspection Report on Sennebec Pond Dam (ME-00248) has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgement and practice, and is hereby submitted for approval.

ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

JOSEPH W. FINEGAN, JR., CHAIRMAN
Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the office of Chief of Engineers, Washington, DC 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions will be detected.

Phase I Investigations are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the test flood is based on the estimated "probable maximum flood" for the region (greatest reasonably possible storm run-off), or a fraction thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential. Consideration of downstream flooding other than in the event of a dam failure is beyond the scope of this investigation.

The Phase I Investigation does <u>not</u> include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be

needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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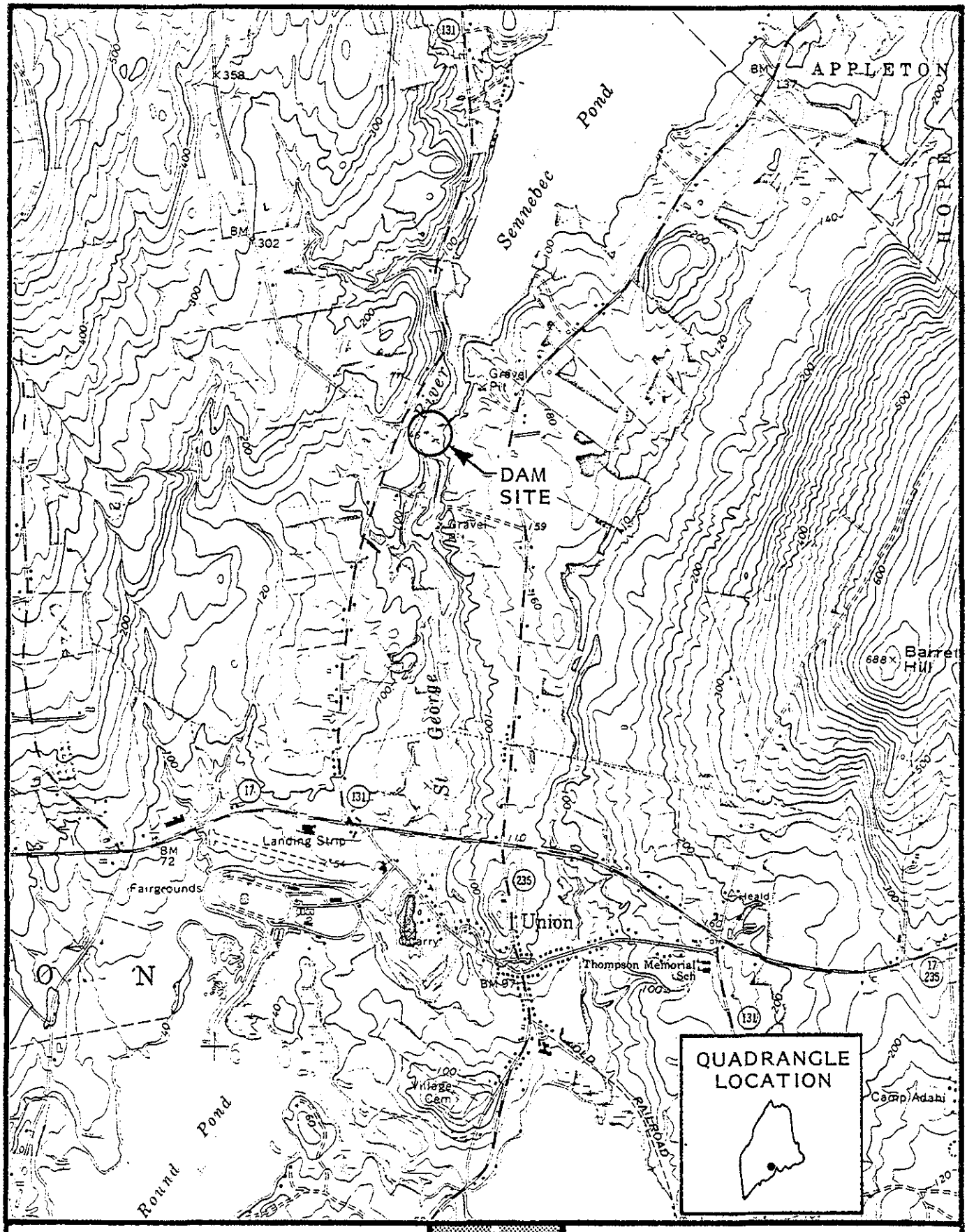


FILE NO. 4454 A52

DAM: Sennebec Pond

IDENTIFICATION NO. ME 00248

N

LOCATION MAP

U.S.G.S. QUADRANGLE

UNION, ME

APPROX. SCALE: 1"= 2000'

PHASE I INVESTIGATION REPORT
NATIONAL DAM INSPECTION PROGRAM

SENNEBEC POND DAM
ME 00248

SECTION 1 - PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, 8 August 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England region.

Haley & Aldrich, Inc. has been retained by the New England Division to inspect and report on selected dams in the States of New Hampshire and Maine. Authorization and notice to proceed were issued to Haley & Aldrich, Inc. under a letter dated 31 October 1979 from Colonel William E. Hodgson, Jr., Corps of Engineers. Contract No. DACW33-80-C0009 has been assigned by the Corps of Engineers for this work. Camp, Dresser & McKee, Inc. was retained as consultant to Haley & Aldrich, Inc. on the structural, mechanical/ electrical and hydraulic/hydrologic aspects of the Investigation.

b. Purpose of Inspection. The primary purposes of the National Dam Inspection Program are to:

1. Perform technical inspection and evaluation of non-federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

2. Encourage and prepare the states to intiate effective dam safety programs for non-Federal dams.

3. Update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location. The dam is located at the southern end of Sennebec Pond in Union, Maine, as shown on the Location Map, page vii. The latitude and longitude of the dam site are N44°13.9' and W69°16.8', respectively. Flow is conveyed from the dam by the St. George River, which outlets at the Town of Cushing, located along the central Maine coast.

b. Description of Dam and Appurtenances. Sennebec Pond Dam, also known as Hills Mills Dam, is a concrete gravity structure with vertical upstream and downstream faces. A single gated opening located at the right side of the dam functions as the outlet works. This opening could also serve as a low level outlet or drain for the reservoir, if required. At the left side of the dam there are three slide gates to regulate flow into a canal that runs adjacent to the left bank of the river for a distance of approximately 1,200 ft. The centerline crest length of the dam is approximately 233 ft. The associated hydraulic height of the dam is approximately 18 ft.

The spillway weir is broad crested and approximately 80-ft. long. At the right spillway training wall, the top of the dam is 6.1 ft. above the spillway weir or at El. 93.1. Recessions in the concrete training walls, possibly used for mounting flashboards or stop logs at some previous time, are located at either end of the spillway. The top of the crest at the right end of the dam is 4-ft. 4-in. wide, from the spillway training wall to the abutment.

The outlet works opening is approximately 5-ft. high by 7-ft. wide with an invert 10.2 ft. below the spillway crest. A wooden slide gate, located on the upstream side, is operated by a manual gate lift mechanism mounted at the top of the dam, 34.5 ft. from the right abutment.

The canal at the left of the river is primarily a cut, excavated in earth, that conveys flow to the concrete forebay of an abandoned generating station located approximately 700 ft. downstream of the dam. Beyond the generating station, water flows through a relatively flat area before

rejoining the St. George River, approximately 500 ft. further downstream. The ridge that separates the canal and river has irregular slopes and is covered with trees, brush and weeds. An unpaved service road runs along the crest of the ridge from the generating station to the dam.

The section of the dam from the left side of the spillway to the left abutment is 102-ft. long. This section forms a headwall across the upstream end of the ridge and canal. The three slide gates convey flow directly into the canal. The concrete at the top of the dam is 4-ft. wide from the spillway to the upstream end of the ridge where it widens to 4 ft. 4 in. at the left abutment.

There is a second, older, canal located along the right side of the downstream channel. The alignment of the canal is discernable though it has been overgrown with forest vegetation. The invert of the canal is above the downstream river channel. The previous use of this canal is unknown, however, the alignment of the upstream portion of the canal is generally coincident with the outlet works opening.

c. Size Classification. The storage to the top of Sennebec Pond Dam is estimated to be 10,700 acre-ft., and the hydraulic height of the dam is approximately 18 ft. Storage of from 1,000 to 50,000 acre-ft. and/or a height of from 40 to 100 ft. classifies a dam in the "intermediate" size category, according to the guidelines established by the Corps of Engineers. Although the height of this dam is much less than 40 ft., it is classified as an "intermediate" size dam by virtue of its storage capacity.

d. Hazard Classification. Dam failure analysis computations in Appendix D which are based on "Guidance for Estimating Downstream Dam Failure Hydrographs" demonstrate why Sennebec Pond Dam has been classified as having a "significant" hazard potential. One house, located approximately 1.4 mi. downstream of the dam, could be impacted. Prior to failure, flooding would be on the order of 1 to 2 ft. below the sill of this structure. The flood wave resulting from a dam failure would range from 1.5 to 2.5 ft. above the sill of this structure and the potential exists for loss of a few lives.

e. Ownership. The name and address of the current owner are:

Sennebec Association
P.O. Box 142
Union, Maine 04862

f. Operator. Mr. Charles Rasmussen, President of the Sennebec Association, has been responsible for operation, maintenance and safety of the dam since 1978. His phone number is (207) 785-4631.

g. Purpose of Dam. Water was once conveyed by the canal along the left downstream channel to a generating station previously owned by the Dirigo Power Company. In 1923, Central Maine Power Company conducted a feasibility study to determine if the power capacity could be increased. However, they never performed the work. The present owner utilizes the dam to maintain the water level of Sennebec Pond for recreational purposes.

h. Design and Construction History. There are no design or construction records available to document when, how and by whom the original dam was built. Drawings from the 1923 feasibility study were provided by Central Maine Power Company.

i. Normal Operational Procedures. There are no formal written procedures for the operation of Sennebec Pond Dam. The spillway has a fixed crest. Flashboards are not used to control seasonal runoff nor are the outlet works or canal gates operated to regulate flow. The President of the Sennebec Association periodically inspects the dam and monitors the upstream water level.

1.3 Pertinent Data

No established elevations for the dam were located other than on plans developed by the Central Maine Power Company dated June 1923. The spillway crest elevation

reported on those plans is El. 85.22. The Union, Maine USGS Quadrangle, 1965, shows the Sennebec Pond water surface at El. 87.0. Since the vertical control used for the Central Maine Power Company plans is unknown and that information predates the establishment of NGVD in 1929, El. 87.0 has been adopted for the spillway crest.

a. Drainage Area. The drainage area tributary to the dam site is about 110 sq. mi. The watershed is sparsely developed and heavily wooded. The terrain is basically flat and coastal with numerous upstream ponds and lakes including St. George and Quantabacook Lakes.

b. Discharge at Dam Site

1. Outlet works.....	470 cfs at El. 87.0
2. Maximum known flood at dam site.....	Unknown
3. Ungated spillway capacity at top of dam.....	4,400 cfs at El. 93.1
4. Ungated spillway capacity at test flood pool elevation.....	8,940 cfs at El. 96.7
5. Gated spillway capacity at normal pool elevation.	Not applicable
6. Gated spillway capacity at test flood pool elevation.....	Not applicable
7. Total spillway capacity at test flood pool elevation.....	8,940 cfs at El. 96.7
8. Total project discharge at test flood pool elevation.....	12,000 cfs at El. 96.7

c. Elevation (ft. above NGVD)

1. Streambed at centerline of dam.....	75.0
2. Maximum tailwater.....	81.8
3. Upstream portal invert diversion tunnel.....	Not applicable
4. Normal pool.....	87.0

5. Full flood control pool..	Not applicable
6. Spillway crest.....	87.0
7. Design surcharge - original design.....	Unknown
8. Top of dam.....	93.1
9. Test flood surcharge.....	96.7

d. Length of Reservoir (mi. estimated)

1. Normal pool.....	2.5
2. Flood control pool.....	Not applicable
3. Spillway crest pool.....	2.5
4. Top of dam.....	3.1
5. Test flood pool.....	3.3

e. Storage (acre-ft.)

1. Normal pool.....	6,700
2. Flood control pool.....	Not applicable
3. Spillway crest pool.....	6,700
4. Top of dam.....	10,700
5. Test flood pool.....	13,500

f. Reservoir Surface (acres)

1. Normal pool.....	560
2. Flood control pool.....	Not applicable
3. Spillway crest.....	560
4. Top of dam.....	748
5. Test flood pool.....	858

g. Dam

1. Type.....	Concrete gravity
2. Crest length.....	233 ft.
3. Height.....	18 ft. (est.)
4. Top width.....	4.3 ft. at right side of spillway 4.0 ft. at left side of spillway
5. Side slopes.....	Vertical U/S and D/S
6. Zoning.....	Unknown
7. Impervious core.....	Unknown
8. Cutoff.....	Unknown
9. Grout curtain.....	Unknown

h. Diversion and Regulating Tunnel. Not applicable

i. Spillway

1. Type.....	Broad crested concrete weir with vertical upstream and downstream faces
2. Length of weir.....	80 ft. (Est.)
3. Crest elevation.....	87.0
4. Gates.....	None
5. U/S channel.....	St. George River from Sennebec Pond
6. D/S channel.....	St. George River, initial slope approximately 0.025
7. General.....	A canal located at the left side of dam runs adjacent to St. George River for approximately 1,200 ft.

j. Regulating Outlet

1. Invert.....	El. 76.8
2. Size.....	7 ft. wide by 5 ft. high (estimated)
3. Description.....	One wooden slide gate located near the right abutment
4. Control Mechanism.....	Manually operated with lift mechanism located at top of dam El. 93.1
5. Other.....	Three slide gates convey flow to canal located at left side of dam

SECTION 2 - ENGINEERING DATA

2.1 Design Data

No design data for the original dam were located and none are believed to exist. Plan and profile drawings from the 1923 Central Maine Power Company feasibility study were located. Included on these drawings are local topographical and geotechnical information.

2-2 Construction Data

No as-built data or records of the construction of the dam were located and none are believed to exist.

2.3 Operation Data

No operational data or prior inspection reports on the facility were located.

2.4 Evaluation of Data

a. Availability. A list of the engineering data available for use in preparing this report is included on page B-1. Selected documents from the listing are also included in Appendix B.

b. Adequacy. There was a lack of engineering data available to aid in the evaluation of Sennebec Pond Dam. This Phase I assessment was therefore based primarily on visual examination, preliminary hydraulic and hydrologic computations, consideration of past performance and application of engineering judgement.

c. Validity. The information contained in the engineering data may generally be considered valid.

SECTION 3 - VISUAL EXAMINATION

3.1 Findings

a. General. The Phase I visual examination of Sennebec Pond Dam was conducted on 7 November 1980. The upstream water surface elevation was about 0.8 ft. above the spillway crest that day.

In general, the project was found to be in fair condition. Several deficiencies which require correction were noted.

A visual inspection check list is included in Appendix A and selected photographs of the project are given in Appendix C. A "Site Plan Sketch", page C-1, shows the direction of view for each photograph.

b. Dam. Sennebec Pond Dam, the spillway, right and left sections, outlet works and canal intake, appeared to be in fair condition overall.

The horizontal and vertical alignments of the dam, Photo Nos. 2 and 3, were satisfactory and did not show evidence of significant lateral movement or settlement. The spillway was obscured from view by flowing water during the site examination. However, based upon those portions of the spillway that could be seen and the uniformity of flow over the weir, this part of the structure appeared to be in good condition. There was a depression 4-in. deep, 12-ft. long and 1.4-ft. wide located at the right end of the spillway, towards the downstream side.

The concrete of the sections to the right and left of the spillway was scaled and spalled. Some concrete was eroded at the right spillway training wall, Photo No. 5, and along the upstream face of the left section of the dam in the vicinity of the spillway waterline, Photo No. 6.

There was slight seepage through the concrete at an intersection of horizontal and vertical construction joints located approximately 29.5 ft. to the left of the left

spillway training wall and coincident with the spillway crest elevation. The water was clear and the quantity of flow was too small to be estimated. There were no associated rust stains in the seepage area but the condition appeared to be long standing. The right and left portions of the dam were in generally satisfactory condition and did not appear to be structurally unstable.

Both the right and left ends of the dam abut steeply sloping rock surfaces covered with boulders and soil. Soil on the slopes supports a thick covering of forest vegetation, Photo Nos. 4 and 8. Rock outcrops were exposed both upstream and downstream of the right abutment. However, based upon available data the dam may be founded on either "hardpan" or "ledge", (see Appendix page B-11), or partially on both.

c. Appurtenant Structures. The outlet works discharges directly into the downstream channel, Photo No. 5. Examination of the outlet works chamber revealed leakage through the deteriorated wood gate. The owner's representative, present during part of the site examination, reported that the upstream side of the outlet works slide gate had been sandbagged during a period of low flow to reduce leakage and help maintain the pond near the recreational pool level. The concrete surface of the gate chamber walls was spalled and eroded; however, no reinforcing was visible. The outlet works gate lift mechanism was operable but, due to the sandbags placed against the upstream side of the gate, it could not be raised. From the conditions both reported and observed, it appeared that the outlet works were readily serviceable.

The three slide gates at the left side of the dam were submerged, thus precluding direct examination. Only one of the three gate lift mechanisms was present, Photo No. 6. It was not operable and did not appear to be in readily serviceable condition. It is not known when the two other gate lift mechanisms were removed. The existence of a tailwater pool in the canal indicated leakage through one or more of the intake gates. It was reported that the three intake gates had also been sandbagged, at the upstream side, to reduce leakage. The concrete training wall at the right side of the canal was in fair condition, Photo No. 7. The visible lower portion of the wall was considerably spalled and eroded, however, alignment of the wall did not indicate major lateral movement or settlement.

The ridge that separates the canal and river channel is covered with mature forest growth, Photo No. 8. Trees up to 12 in. in diameter were located within several feet of the downstream face of the dam, Photo No. 9. The service roadway along the crest of the ridge had a thick covering of grass and weeds. Several fallen trees block the roadway. The slopes on either side of the ridge, though steep, appeared to be stable.

d. Reservoir Area. The banks of Sennebec Pond are lightly developed with residential homes and cottages. Most of the structures are located below El. 100 according to the USGS Union, Maine, Quadrangle Map. The pond has an elongated shape measuring about 0.6-mi. wide by about 2-mi. long. A narrow approach channel about 100-ft. wide extends approximately 2,000 ft. from the pond to the dam. No conditions were observed which could cause landslides into the pond or approach channel.

e. Downstream Channel. The St. George River flows from the dam through the Town of Union, Maine, to Round Pond, a distance of about 3 mi. The elevation difference between the water surfaces of Sennebec Pond and Round Pond is about 53 ft. There are a total of three bridges which cross the river between the dam and Round Pond.

3.2 Evaluation

Based on the visual examination conducted on 7 November 1980, Sennebec Pond Dam is considered to be in fair condition. The remedial measures outlined in Section 7.3 should be implemented to correct the noted deficiencies in the concrete, outlet works and canal intake gates; monitoring of the seepage condition and removal of the trees at the right and left abutments and upstream end of the ridge should also be performed.

SECTION 4 - OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

a. General. There are no procedures to provide for the satisfactory operation of the dam.

b. Description of Any Warning System in Effect. There is no warning system or emergency preparedness plan in effect for this structure.

4.2 Maintenance Procedures

a. General. There are no established procedures or manuals for inspection and maintenance of the dam.

b. Operating Facilities. The spillway does not appear to receive regular maintenance. Flashboards are not utilized to regulate the water level of Sennebec Pond. There are no formal plans to maintain the outlet works or canal intake gates. None of the gates were operable at the time of the site examination.

4.3 Evaluation

The owner should prepare an operations and maintenance manual for the dam. The manual should delineate the routine operational procedures and maintenance work to be done on the dam to provide satisfactory operation and minimize deterioration of the facility. For example, an annual observation and maintenance program should be established to examine the dam, control vegetation growth and maintain slopes, walls and channels. A formal procedure should be established for periodic operation of the outlet works.

Since failure of the dam could cause the loss of a few lives as well as extensive property damage downstream, the owner should also prepare and implement a formal emergency preparedness plan and downstream warning system.

SECTION 5 - EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 General

Sennebec Pond Dam is a run-of-the-river dam located on the St. George River. An approximately 2,000-ft. long by 100-ft. wide section of the St. George River serves as the approach channel from Sennebec Pond to the dam. The overall length of the dam is approximately 233 ft. which includes an 80-ft. long broad crested concrete spillway with a vertical downstream face. The outlet works, located to the right of the spillway, consists of one gated opening approximately 5-ft. high by 7-ft. wide. In addition, there are three wooden slide gates located to the left of the spillway which outlet to a canal. The spillway crest elevation has been assumed to be at El. 87.0 and the top of the dam at El. 93.1. The 110 sq. mi. drainage area is typical of flat and coastal terrain with numerous ponds and lakes throughout the watershed.

5.2 Design Data

There is no hydraulic/hydrologic design data available for the dam.

5.3 Experience Data

No records of historical floods at the dam site were located.

5.4 Test Flood Analysis

Based on the Corps of Engineers Guidelines, the recommended test flood range for the size "intermediate" and hazard potential "significant" is the 1/2 PMF to a full PMF (Probable Maximum Flood). The 1/2 PMF was adopted as the test flood for this site as Sennebec Pond Dam is in the low end of the size classification range. The test flood was determined using the Corps of Engineers Guidelines for

"Estimating Maximum Probable Discharge" in Phase I Dam Safety Investigations. The 110 sq. mi. watershed tributary to Sennebec Pond Dam is typical of flat and coastal terrain with extensive natural flood plain storage. A peak inflow rate of 125 csm was selected for the 1/2 PMF inflow. This results in a test flood inflow to Sennebec Pond of 13,750 cfs.

Surcharge storage routing of the test flood inflow resulted in a test flood outflow of 12,000 cfs at a pond stage of El. 96.7 or about 3.6 ft. above the top of dam. The spillway capacity with water at top of dam (no overtopping) is 4,400 cfs or about 37 percent of the routed test flood outflow.

5.5 Dam Failure Analysis

Based on Corps of Engineers Guidelines for Estimating Dam Failure Hydrographs, and assuming that a failure would occur along 40 percent of the mid-height length of the dam with the pond level at top of dam, the combined peak failure outflow is estimated to be about 8,000 cfs. There appears to be no existing development which would be effected by this flow between the dam and the first downstream bridge located about 1.1 mi. downstream of the dam. However, approximately 1,300 ft. further downstream there is a much smaller bridge with a house located immediately upstream and extending out into the river channel. Prior to failure, flooding would be on the order of 1 to 2 ft. below the sill of this structure. The flood wave resulting from a dam failure would range from 1.5 to 2.5 ft. above the sill of this structure and could severely damage the building. There does not appear to be any additional development downstream of the house to the junction of the St. George River and Round Pond that would be impacted by a dam failure.

The potential loss of life resulting from a dam failure is a few and the dam is accordingly classified in the "significant" hazard category.

SECTION 6 - EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observations

There was no visual evidence of settlement, lateral movement or other signs of structural instability in the dam during the site examination. However, the reservoir level was high and the spillway was obscurred by flowing water making a detailed examination impractical. Based on those conditions that were observed, no reason was found to question the static structural stability of the dam.

6.2 Design and Construction Data

No design or construction data were located for this dam.

6.3 Post-Construction Changes

There have been no known material modifications to the Sennebec Pond Dam since its original construction. Central Maine Power Company studied the feasibility of enlarging the facility in 1923, but, the proposed reconstruction was never performed.

6.4 Seismic Stability

Sennebec Pond Dam is located in a Seismic Zone 2 and in accordance with recommended Phase I Guidelines does not warrant seismic analysis.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. The visual examination of Sennebec Pond Dam revealed that the structure was in fair condition. Although there were no signs of impending structural failure or other conditions which would warrant urgent remedial action, several deficiencies were noted.

Based on the results of computations included in Appendix D and described in Section 5, the spillway is not capable of passing the adopted test flood, which for this structure is 1/2 PMF. The routed test flood outflow of 12,000 cfs (inflow 13,750 cfs or 125 csm) would overtop the dam by about 3.6 ft. With the water level at the top of dam, the spillway capacity is about 4,400 cfs, which is 37 percent of the routed test flood outflow.

b. Adequacy of Information. The evaluation of the dam is based primarily on visual examination, preliminary hydraulic and hydrologic computations, consideration of past performance and application of engineering judgement. Generally, the information available or obtained was adequate for the purpose of a Phase I assessment.

c. Urgency. The recommendation for an additional investigation and remedial measures outlined in Sections 7.2 and 7.3, respectively, should be undertaken by the Owner and completed within one year after receipt of this report.

7.2 Recommendations

It is recommended that the following investigation be performed under the direction of a registered professional engineer.

1. The engineer should perform a detailed hydologic and hydraulic investigation to assess further the need for and means to increase the project discharge capacity and the ability of the dam to withstand overtopping.

The owner should then implement corrective measures on the basis of this engineering investigation.

7.3 Remedial Measures

Although the dam is generally in fair condition, it is considered important that the following items be accomplished.

a. Operation and Maintenance Procedures. The following should be undertaken by the Owner:

1. Repair the spalled and eroded areas of the concrete portions of the dam including the depression located at the right end of the spillway weir.

2. Make repairs as necessary to restore the outlet works gate to serviceable condition. Also, the owner should consider repairing the three canal intake gates to serviceable condition or sealing the openings to prevent leakage.

3. Establish a program for monitoring the seepage at the downstream face of dam to the left of the spillway. While the seepage observed did not appear significant, repairs may be necessary if the condition worsens.

4. Cut the trees at both abutments and on the ridge adjacent to the downstream face of the dam. Stumps and major root systems should be removed and voids filled with suitable compacted material.

5. Prepare an operations and maintenance manual for the dam. The manual should include provisions for annual technical inspection of the dam and for round-the-clock surveillance of the dam during periods of heavy precipitation

and high discharges. The procedures should delineate the routine operational procedures and maintenance work to be done on the dam to ensure safe, satisfactory operation and to minimize deterioration of the facility.

The next technical inspection should preferably be scheduled during a period of low flow to allow a more detailed inspection of the spillway.

6. Develop a written emergency preparedness plan and warning system to be used in the event of impending failure of the dam or other emergency conditions for the specific dam. The plan should be developed in cooperation with local officials and downstream inhabitants.

7.4 Alternatives

There are no practical alternatives to the above recommendations.

APPENDIX A - INSPECTION CHECK LIST

VISUAL INSPECTION PARTY ORGANIZATION
NATIONAL DAM INSPECTION PROGRAM

Dam: Sennebec Pond Dam

Date: 7 November 1980

Time: 13:00-16:00

Weather: Clear - Temperature in low 50's

Water Surface Elevation Upstream: Approximately 0.8 ft. above spillway crest

Stream Flow: Approximately 170 cfs

Inspection Party:

Douglas G. Gifford	-	Soils/Geology
Charles R. Nickerson Haley & Aldrich, Inc.		
Joseph E. Downing	-	Hydraulic/Hydrologic
Francis E. Luttazi Camp, Dresser & McKee, Inc.	-	Structural/Mechanical

Present During Inspection:

Charles Rasmussen - President Sennebec Association (for part of the time)

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Sennebec Pond Dam DATE: 7 Nov. 80

AREA EVALUATED	CONDITION
POWER CHANNEL AND INTAKE GATES	NOTE: Power channel located D/S to the left of the spillway. Provisions for three sluice gates on the U/S face of the dam were observed opposite the channel and apparently serve as the canal intakes
a. Approach Channel	Intake gates front on Sennebec Pond. See "Spillway Approach Channel"
b. Intake Gates	All three sluice gates were inoperable. Only one mechanical gate operator present. Reportedly, all three gates have been sandbagged at U/S face. Small tailwater pool D/S of gates noted
c. Discharge Channel	Floor of channel submerged. Banks of channel are wooded with mature tree growth
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	NOTE: A single gate operator and slide gate were located to the right of the spillway. It was reported that this gate was also sandbagged and inoperable. The gate outlet on the D/S face of the dam emptied directly into the main spillway discharge channel
DAM, SPILLWAY, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	
General Condition	Good
Loose Rock Overhanging Channel	None noted
Trees Overhanging Channel	Right and left banks are tree lined. Wooded island located U/S of dam at approximately mid-channel

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Sennebec Pond Dam DATE: 7 Nov. 80

AREA EVALUATED	CONDITION
Floor of Approach Channel	Submerged
b. Dam and Spillway	
General Condition of Concrete	Spillway weir submerged. General condition of visible portions of dam to right and left of spillway was good
Rust or Staining	None noted
Spalling	Spalling and scaling noted at U/S and D/S face of dam to right and left of spillway. Spalling observed at dam crest to right of spillway
Any Visible Reinforcing	None noted
Any Seepage or Efflorescence	Seepage through concrete observed at D/S face of dam, 29.5 ft., to left of spillway at intersection of horizontal and vertical joints. Concrete moist at this location along horizontal joint in several areas. Leakage observed through wooden slide gate located to right of spillway
Drain Holes	None noted
c. Discharge Channel	
General Condition	Good
Loose Rock Overhanging Channel	Stone rubble/debris noted in channel. Field stone training wall noted paralleling right bank
Trees Overhanging Channel	Right and left bank tree lined. Wooded islands noted D/S of spillway
Floor of Channel	Submerged

APPENDIX B - ENGINEERING DATA

LIST OF AVAILABLE DATA
SENNEBEC POND DAM

Document	Contents	Location
St. Georges River Development	Six sheets with cost estimates for construction of larger dam and increasing capacity of hydro electric generating facilities at site dated April 1923, pages B-2 to B-7	Central Maine Power Company Edison Drive Augusta, Maine 04336

April 4, 1923

Revised Estimate
To Elevation 120

ST. GEORGES RIVER DEVELOPMENT

Dam at Location of Present Shaw Dam, Elevation Water Surface 120.
Average Head 50 ft. Installation 1 - 3500 H.P. Vertical Unit.
Annual Output 5,400,000 K.W.H.
Drawing No. R-560.

DAM & ABUTMENTS		
Coffer Dams	$ 3,000.	
Excavation, 1670 yds. Rock @ $3	5,000.	
Concrete M, 2170 cu. yds. @ $14	30,400.	
Concrete R, 450 cu. yds. @ $20	9,000.	
Embankment, 66000 cu. yds. @ 60¢	39,600.	
Steel Piling	9,400.	
Rip Rap, 4000 sq. yds. @ $2	8,000.	
Gate, Hoist and Racks	3,000.	
2 - Taintor Gates and Hoist	3,600.	$111,000.
PENSTOCK		
Excavation, 6000 yds. Earth @ $1	6,000.	
Excavation, Rock	200.	
Timber Saddles, 18 M @ $70	1,300.	
Concrete Piers, 25 yds. @ $20	500.	
600 Ft. 9'6" Diameter Penstock @ $22.50	13,500.	
Distributing	500.	22,000.
POWER HOUSE SUBSTRUCTURE		
Coffer Dam and Pumping	3,000.	
Excavation, 1300 yds. Earth @ $2	2,600.	
Concrete, 830 yds. @ $16	13,400.	
Structural Steel	1,400.	
Reinforcing Steel	3,000.	23,400.
POWER HOUSE SUPERSTRUCTURE		
30,000 cu. ft. @ 30¢	8,000.	
Crane	3,000.	11,000.
TAILRACE		
2500 yds. Rock, Sand and Gravel @ $2.75	7,000.	7,000.
TURBINE		
Turbine and Governor	31,700.	
Stand Pipe	5,000.	
Freight, Unloading and Teaming	1,800.	
Erection	2,500.	41,000.
		$215,400.

Brought Forward		$215,400.
ELECTRICAL EQUIPMENT		
Generator and Exciter	$23,000.	
ATI Winding	550.	
Oiling System	450.	
Freight and Teaming	1,500.	
Erection	2,500.	
Switchboard and Erection	4,000.	
Conduit and Power House Wiring	2,000.	
P.H. Trans., Storage Bat., Misel.	1,000.	35,000.
MISCL. HYD. PLANT EQUIPMENT		
Water Gages and Meters	100.	
Miscellaneous Fixtures	500.	
Construction Buildings	1,500.	
Plant Charge, Installation and Removal	25,000.	
Plant Operation	4,000.	
Small Tools	2,000.	
Trucking	4,000.	
Commissary and Lodging	10,000.	
Roads	900.	48,000.
GENERAL		
Engineering and Supt.	12,000.	
Injuries and Damages	1,500.	
Field Office	2,500.	16,000.
		$314,400.
Interest during Construction		15,000.
Contingencies, Distributed on Items		
Total Construction Costs Dam and Power Plant		329,400.
TRANSFORMER STATION & TRANSMISSION		
3 - 1000 KVA Transformers	6,000.	
Oil Switch	2,000.	
Arresters	1,000.	
Substation Structure	4,000.	
2 Air Brake Switches	1,200.	
¾ Mile Double Trans. Line	5,000.	
Interest during Construction	800.	22,000.
Total Construction Cost		351,400.
Original Property Cost		20,000.
Relocating Highways		12,000.
New Property to be Purchased		29,000.
Interest on Property		3,000.
		$415,400.

April 4, 1923

Revised Estimate
To Elevation 125

ST. GEORGES RIVER DEVELOPMENT

Dam at Location of Present Shaw Dam, Elevation Water Surface 125.
Average Head 50 ft. Installation 1 - 3500 H.P. Vertical Unit.
Annual Output 5,670,000 K.W.H.
Drawing No. R-560.

DAM & ABUTMENTS		
Coffer Dams	$ 3,000.	
Excavation, 1670 yds. Rock @ $3	5,000.	
Concrete M, 2600 yds. @ $15	39,000.	
Concrete R, 630 yds. @ $20	12,600.	
Embankment, 86000 yds. @ 60¢	51,600.	
Steel Piling	10,000.	
Rip Rap, 4200 sq. yds. @ $2	8,400.	
Gate, Hoist and Racks	3,000.	
2 - Taintor Gates & Hoist	4,000.	$136,600.
PENSTOCK		
Excavation, 6000 yds. Earth @ $1	6,000.	
Excavation, 230 yds. Rock	700.	
Timber Saddles, 18 M @ $70	1,300.	
Concrete Piers, 25 yds. @ $20	500.	
600 Ft. 9'6" Diameter Penstock @ $22.50	13,500.	
Distributing	500.	22,500.
POWER HOUSE SUBSTRUCTURE		
Coffer Dam and Pumping	3,000.	
Excavation, 1300 yds. Earth @ $2	2,600.	
Concrete, 830 yds. @ $16	13,400.	
Structural Steel	1,400.	
Reinforcing Steel	3,000.	23,400.
POWER HOUSE SUPERSTRUCTURE		
30,000 cu. Ft. @ 30¢	8,000.	
Crane	3,000.	11,000.
TAILRACE		
2500 yds. Rock, Sand and Gravel @ $2.75	7,000.	7,000.
TURBINE & GOVERNOR		
Turbine and Governor	31,700.	
Stand Pipe	5,000.	
Freight, Unloading and Teaming	1,800.	
Erection	2,500.	41,000.
		$241,500.

Brought Forward		$241,500.
ELECTRICAL EQUIPMENT		
Generator and Exciter	$23,000.	
ATI Winding	550.	
Oiling System	450.	
Freight, Teaming and Erection	3,500.	
Switchboard and Erection	4,000.	
Conduit and Power House Wiring	2,000.	
P.H. Trans., Storage Bat., Misc.	1,500.	36,000.
MISCL. HYD. PLANT EQUIPMENT		
Water Gages and Meters	100.	
Miscellaneous Fixtures	500.	
Construction Buildings	1,500.	
Plant Charge, Installation and Removal .	25,000.	
Plant Operation	4,000.	
Small Tools	2,000.	
Trucking	4,000.	
Commissary and Lodging	12,000.	
Roads	900.	50,000.
GENERAL		
Engineering and Supt.	14,000.	
Injuries and Damages	2,000.	
Field Force Office	2,500.	18,500.
		$345,000.
Interest During Construction		16,000.
Contingencies, Distributed in Items		
Total Construction Costs Dam and Power Plant ...		$361,000.
TRANSFORMER STATION & TRANSMISSION		
3 - 1000 KVA Transformers	6,000.	
Oil Switch	2,000.	
Arresters	1,000.	
Substation Structure	4,000.	
2 - Air Brake Switches	1,200.	
2/2 Mile Double Trans. Line	5,000.	
Interest during Construction	800.	22,000.
Total Construction Cost		383,000.
Original Property Cost		20,000.
Relocating Highways		15,000.
New Property to be Purchased		45,000.
Interest on Property		4,000.
		$467,000.

April 12, 1923

ESTIMATED COST OF CHEROY ST. CROIX RIVER

TO ELEVATION 120 FT. OUTPUT 5,400,000 KWH

COST POWER ON STATION BUSSES

Construction 12% on $329,400.	$39,600.
Operation	6,000.
	$45,600.

Generating Cost per KWH - $.00845

COST ON H.T. LINE AT UNION

Construction	12% on	$329,400.	$39,600.
Transformer Station	15% on	22,000.	3,300.
Land	12% on	64,000.	7,700.
Operation			6,000.
		$415,400.	$56,600.

Cost per KWH - $.0105

COST DELIVERED AT HIGH TENSION SIDE PRESENT TRANS., ROCKLAND

Charges as Above	$56,600.
Cost of Transmission Line, 12 Miles, $45,000, .15% Charge.....	6,800.
	$63,400.

Cost per KWH - $.0117

TO ELEVATION 125 FT. OUTPUT 5,670,000 KWH

COST POWER ON STATION BUSSES

Construction 12% on $361,000.	$43,300.
Operation	6,000.
	$49,300.

Generating Cost per KWH - $.0087

COST ON H.T. LINE AT UNION

Construction 12%	on	$361,000	$43,300.
Transformer Station	15% on	22,000	3,300.
Land	12% on	84,000	10,100.
Operation			6,000.
		$467,000.	$62,700.

Cost per KWH - $.011

COST DEL. HIGH TENSION SIDE PRESENT TRANS., ROCKLAND

Charges as Above	$62,700.
Cost of Transmission Line, $45,000. 15% Charge	6,800.
	$69,500.

Cost per KWH - $.0122

ESTIMATED COST OF ENERGY - ST. GEORGES RIVER

CREDITING CONSTRUCTION COST BY $100,000
FOR VALUE AS A RESERVE.

TO ELEVATION 120 — OUTPUT 5,400,000 KWH

COST ON STATION BUSSES

Construction 12% on $329,400, less $100,000 Credit	$27,500.
Operation	6,000.
	$33,500.

Generating Cost per KWH
$.0062

COST ON H.T. LINE AT UNION

Construction	12% on $329,400 less $100,000 Credit	$27,500.
Transformer Station	15% on $ 22,000.	3,300.
Land	12% on 65,000.	7,800.
Operation		6,000.
		$44,600.

Cost Per KWH - $.00827

TO ELEVATION 125 — OUTPUT 5,670,000 KWH

COST POWER ON STATION BUSSES

Construction 12% on $361,000 less $100,000 Credit	$31,300.
Operation	6,000.
	$37,300.

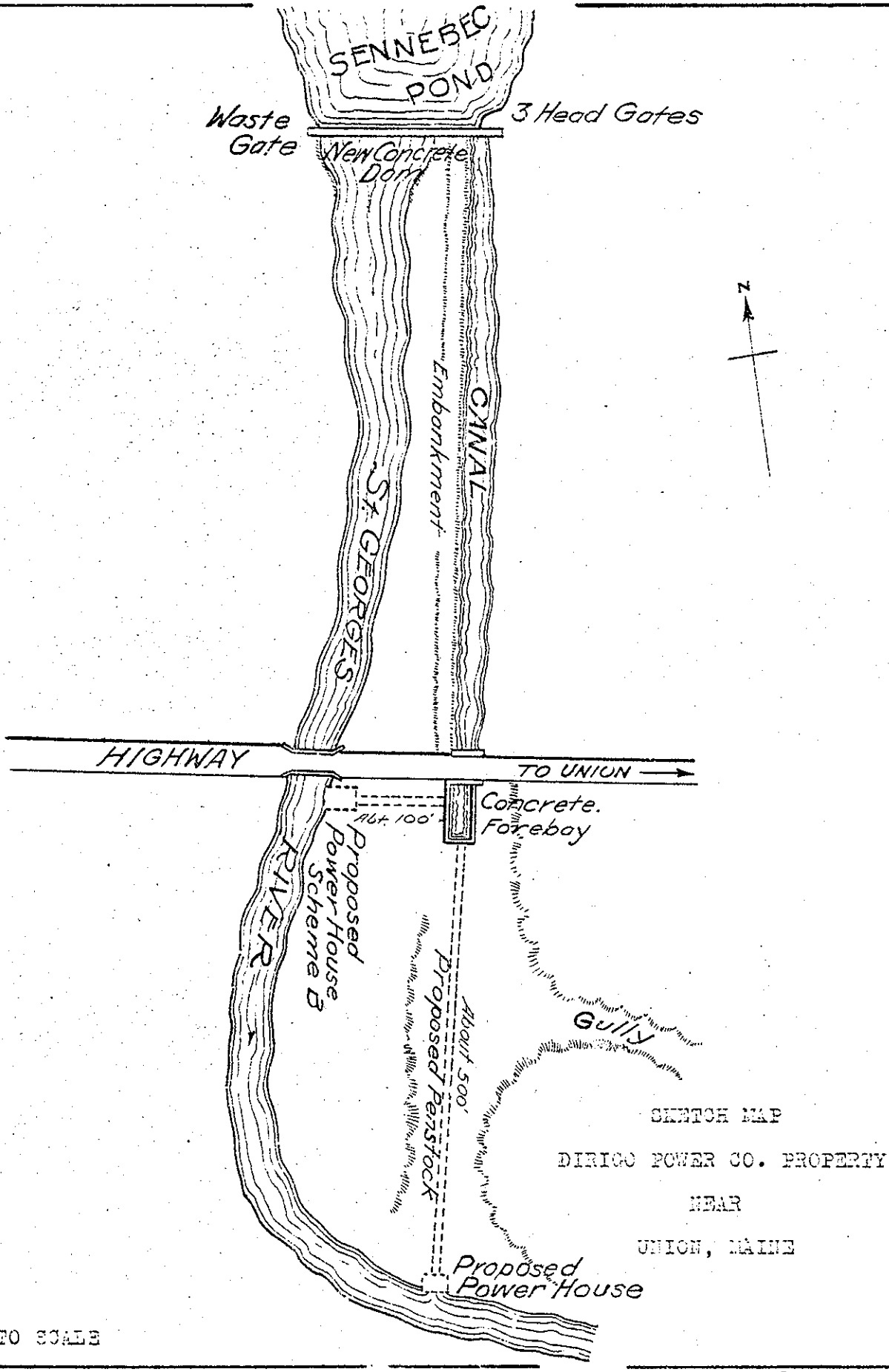
Generating Cost per KWH - $.00658

COST ON H.T. LINE AT UNION

Construction	12% on $361,000 less $100,000 Credit	$31,300.
Transformer Station	15% on $ 22,000.	3,300.
Land	12% on 84,000.	10,100.
Operation		6,000.
		$50,700.

Cost per KWH - $.00895

4/10/23
BLHopkins



SKETCH MAP

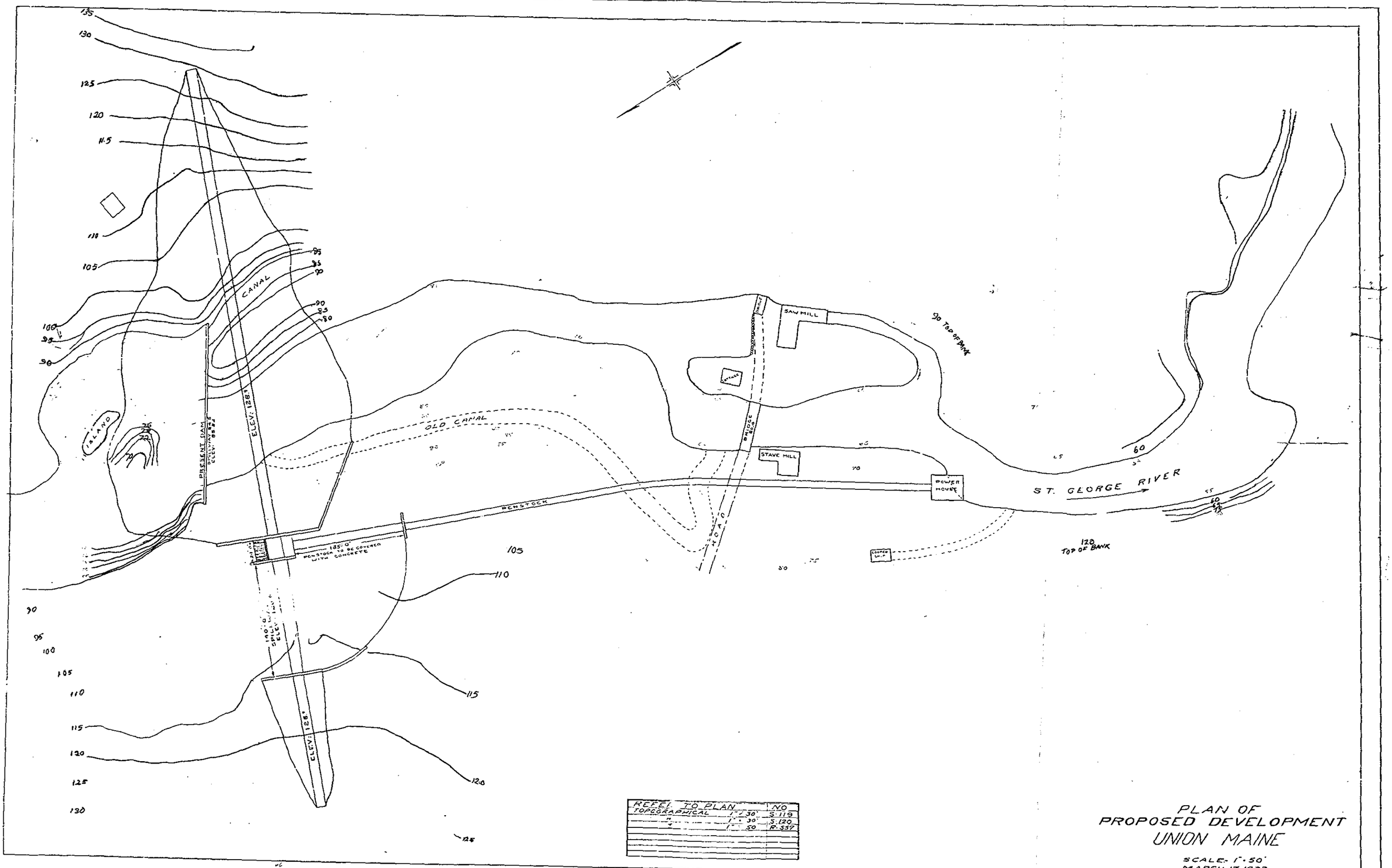
DIRIGO POWER CO. PROPERTY

NEAR

UNION, MAINE

Nov. 1918

SC48

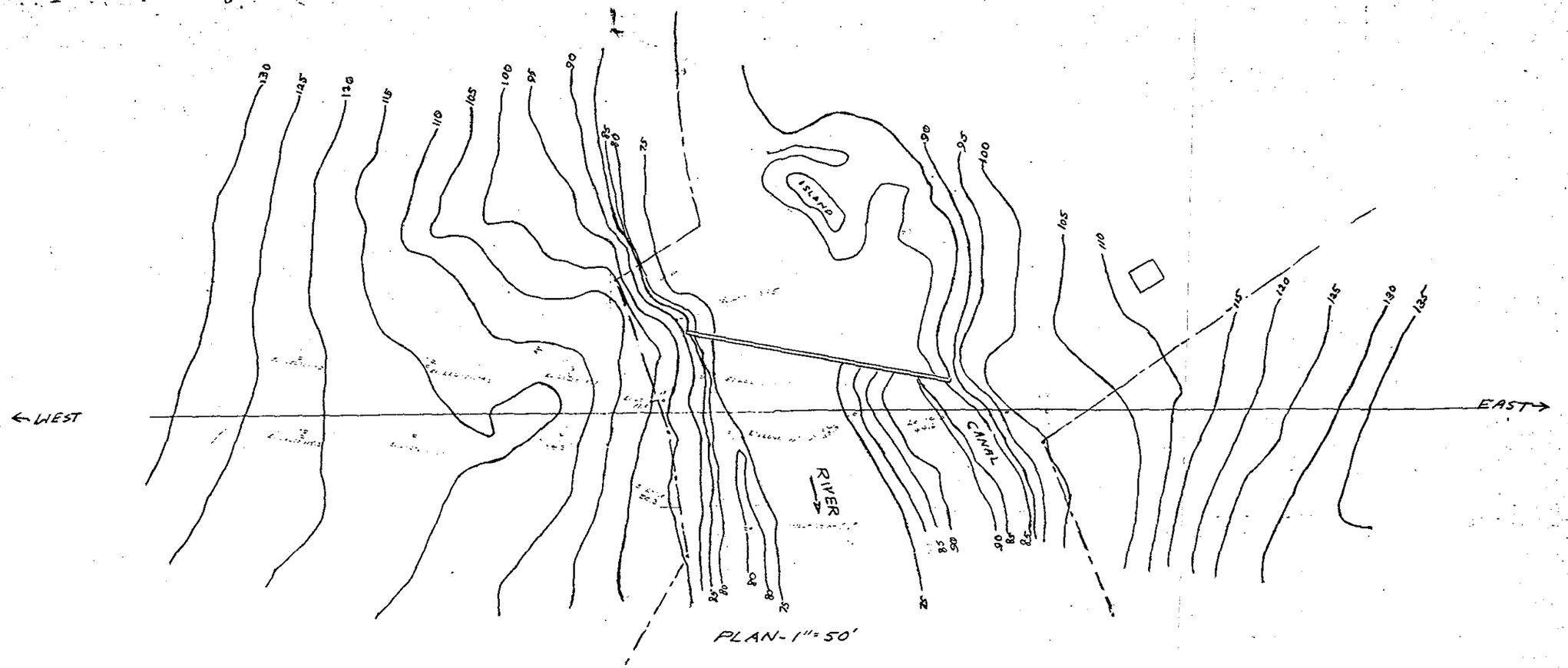


REFER TO PLAN		NO
TOPOGRAPHICAL	1"=30'	S.119
"	1"=30'	S.120
"	1"=50	R.557

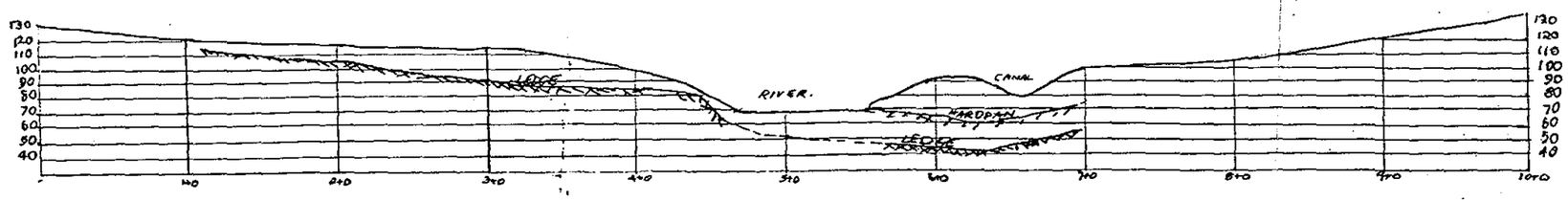
PLAN OF PROPOSED DEVELOPMENT UNION MAINE

SCALE- 1"=50'
MARCH 17 1923

R-558



PLAN - 1" = 50'



PROFILE - VERT. 1" = 50'
HOR. - 1" = 50'

CENTRAL MAINE POWER CO.
UNION - MAINE.

PLAN + PROFILE OF PROPOSED DAM SITE.

0 100 FT.
50

MAY-31-1923.

SA-13

PITS DUG AT IALLO	PITS DRILLED
1	H-1
2	H
3	F
4	E
	C-N
6	D-1
	C
8	D
9	D-S
10	A-B
11	16
18	26
19	27
30	28
31	29
32	33
	G

PLAN
SCALE: 1" = 50'

PROFILE
VERT. SCALE: 1" = 50'
HOR. SCALE 1" = 50'

VERT SCALE: 1" = 20'
HOR. " 1" = 50'

CENTRAL MAINE POWER CO.
UNION MAINE
PLAN AND PROFILE
OF PROPOSED DAM
SCALE: AS NOTED JUNE 11-1923

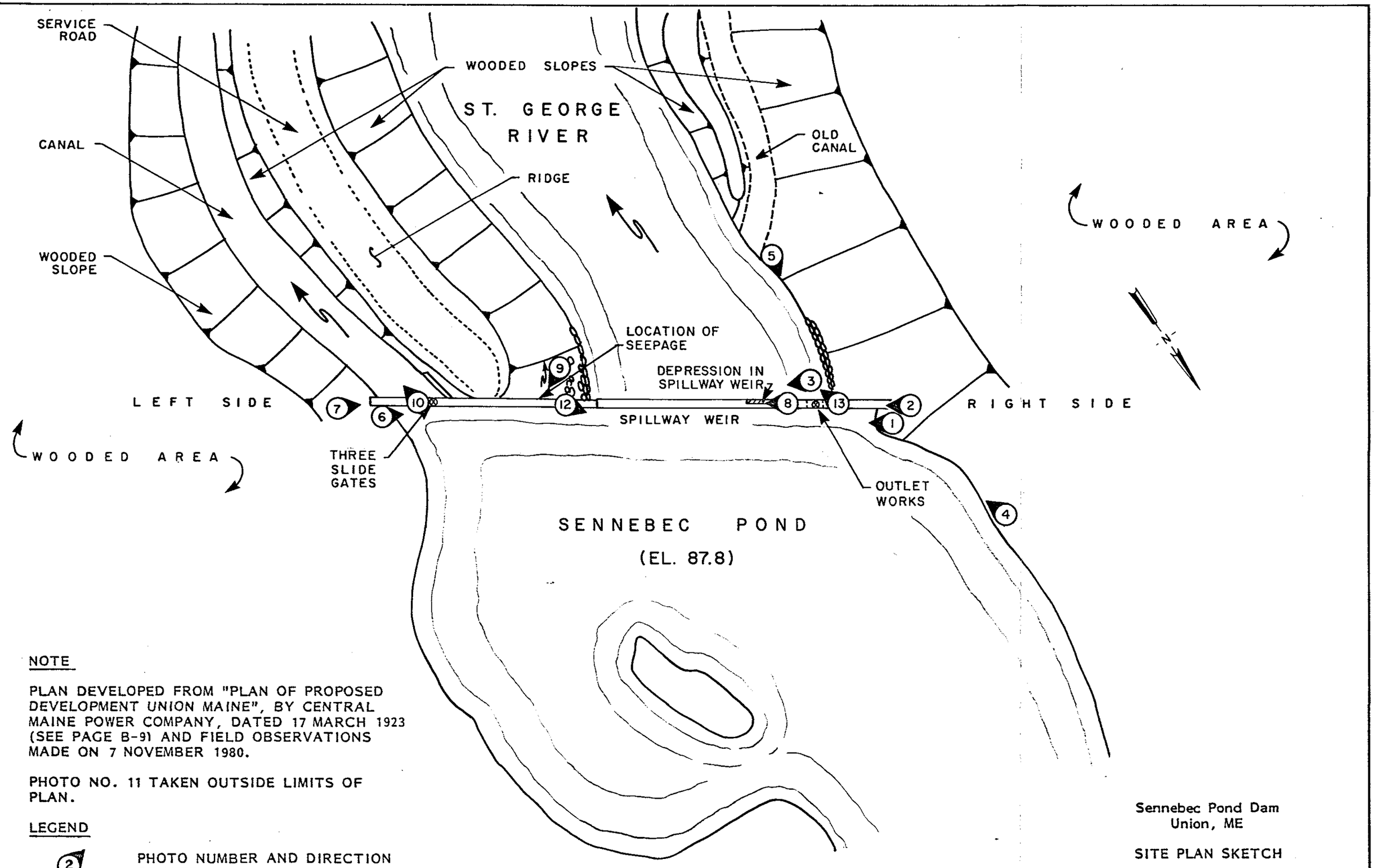
REVISED AUG 9 1923 Test Pits
REVISED JULY 17 1923 TEST PITS R-601-A

R-601-A

R-601-A

B-11

APPENDIX C - PHOTOGRAPHS



NOTE

PLAN DEVELOPED FROM "PLAN OF PROPOSED DEVELOPMENT UNION MAINE", BY CENTRAL MAINE POWER COMPANY, DATED 17 MARCH 1923 (SEE PAGE B-9) AND FIELD OBSERVATIONS MADE ON 7 NOVEMBER 1980.

PHOTO NO. 11 TAKEN OUTSIDE LIMITS OF PLAN.

LEGEND

(2) PHOTO NUMBER AND DIRECTION OF VIEW

HALEY & ALDRICH, INC.
CAMBRIDGE, MASSACHUSETTS

FILE NO. 4454 01 B63

Sennebec Pond Dam
Union, ME

SITE PLAN SKETCH

Approx. Scale: 1" = 40' April 1981

2. Vertical alignment of dam from right abutment

3. Horizontal alignment of spillway crest, downstream

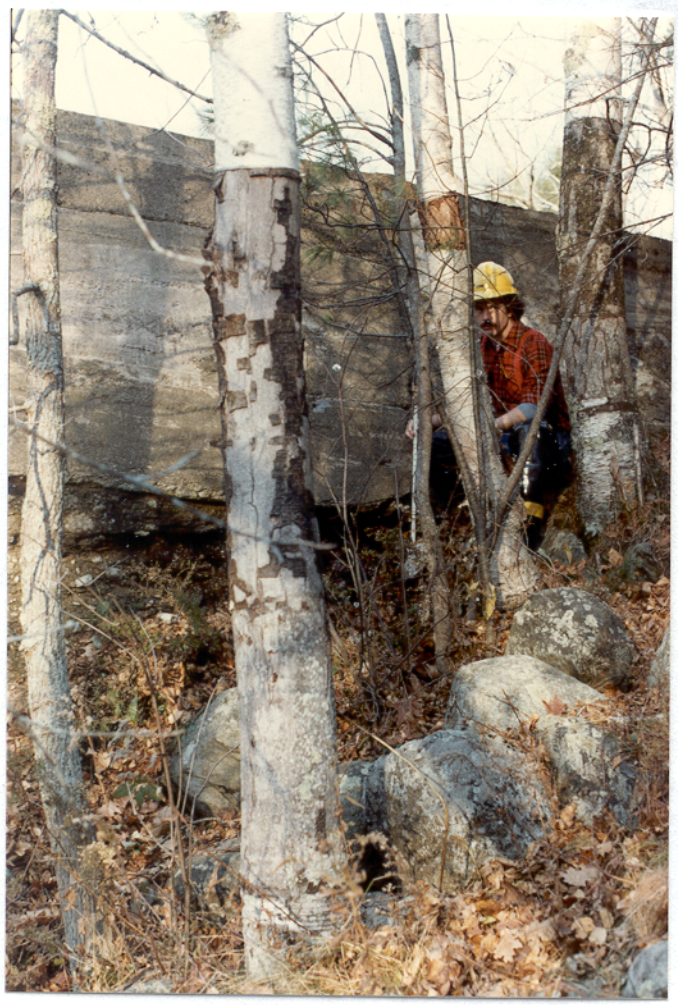
4. Right abutment, upstream

5. Right abutment and outlet works, downstream

6. Left side of dam, upstream

7. Alignment of dam at left abutment

8. Ridge that separates river channel from canal, located at left side of dam, and left abutment



9. Location of seepage through concrete at right side of ridge, downstream

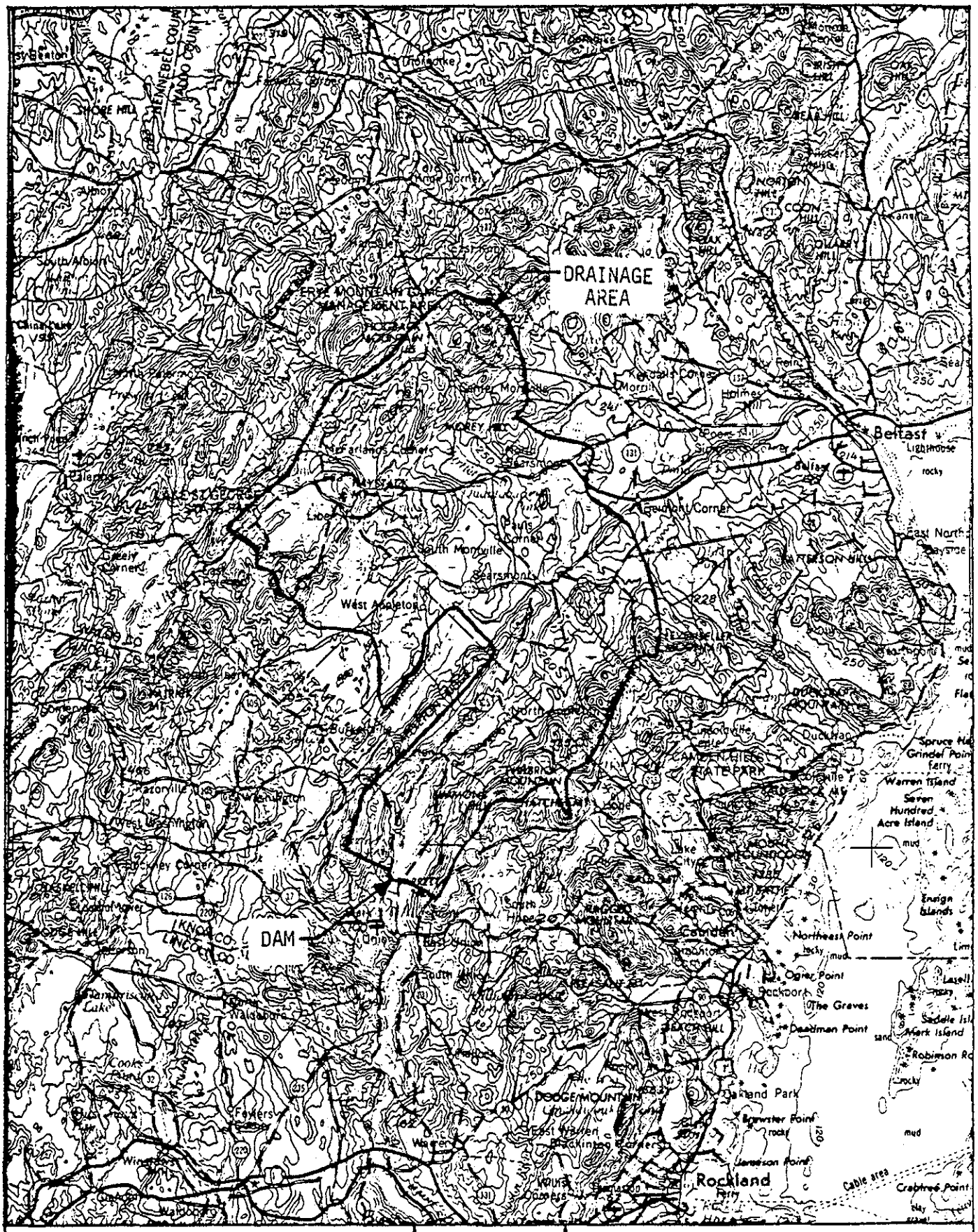
10. Canal alignment immediately downstream from dam

11. Concrete forebay at abandoned generating station, 700 ft. downstream from dam

12. Approach channel from left side of dam

13. Downstream channel from right side of dam

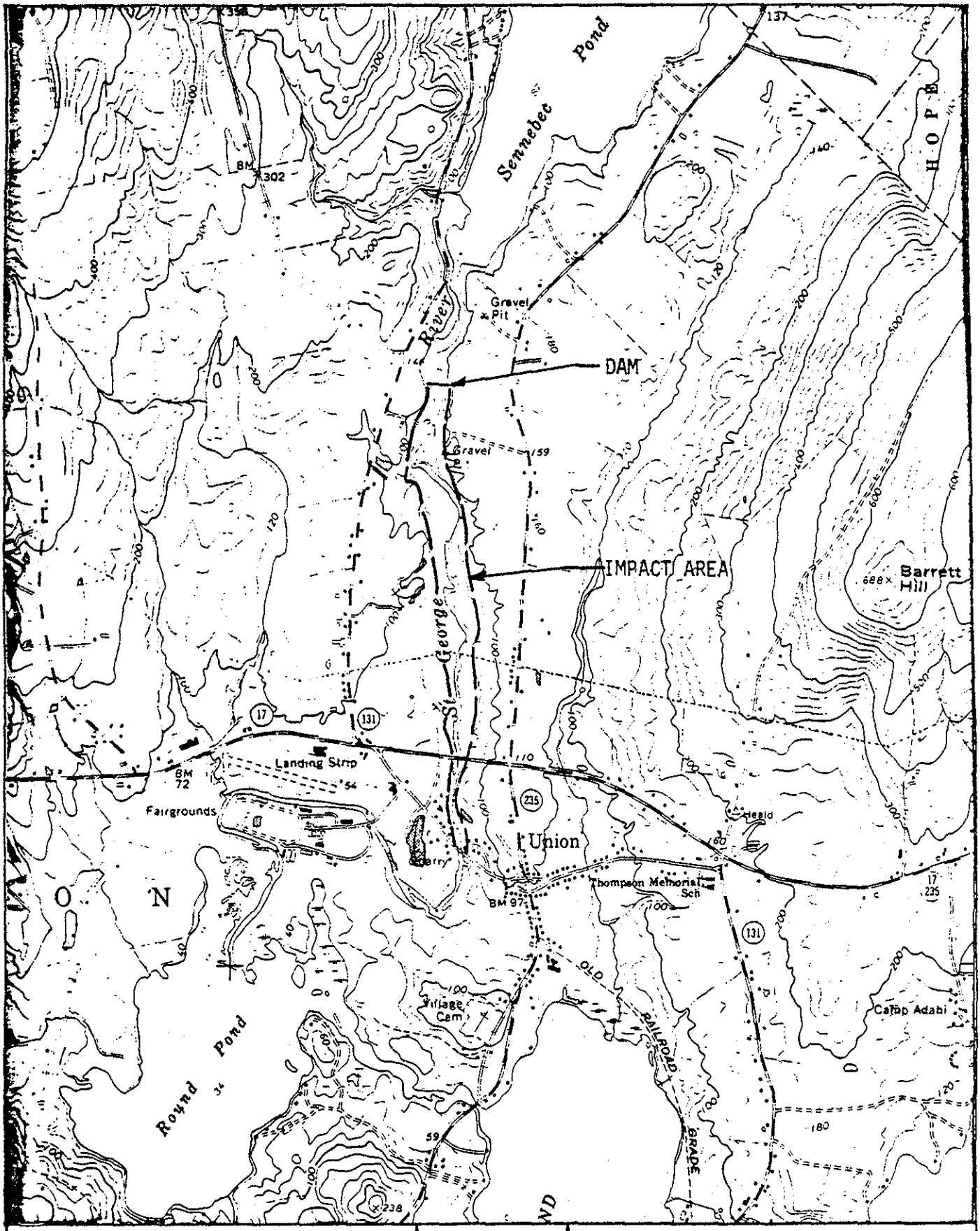
APPENDIX D - HYDRAULIC AND HYDROLOGIC COMPUTATIONS



SENNEBEC POND DAM
ME 00248

DRAINAGE AREA MAP

Approx. Scale: 1" = 4 miles



SENNEBEC POND DAM
ME 00248

DAM FAILURE
IMPACT AREA MAP

APPROX. SCALE: 1" = 2,000'

ELEVATIONS

No established elevation datum was located for the dam other than plans developed by the Central Maine Power Co. dated June, 1923. The spillway crest elev. reported on these plans is elev. 85.22. Since the vertical control (datum) used for these plans is unknown and predates the established MSL of 1927, the pond elev. of 87.0 for Sennebec Pond presented on the Union, Me. Quad (1965) will be adopted as the spillway crest elevation. All other elevations are based on field measurements relative to the assumed datum.

Spillway Crest Elev.	87.0
Top of Dam Elev.	93.1
Toe of Dam Elev.	~75.0 (est.)
Inv. of Outlet Works at Right Abut.	~76.8

FEATURES

Length of Spillway : 80 ft.
Length of Rt. Abut. : 51 ft.
Length of Lt. Abut. : 102 ft.

Outlet Works, Rt. Abut.: one wooden gate approx. 5'H x 7' H, Inv. El. about 76.8 reportedly backfilled at u/s face with sand bags

SURFACE AREAS

Drainage Area ~ 110 sq. mi.

W.S. Area at El. 87.0 ≃ 560 acres
W.S. Area at El. 100.0 ≃ 960 acres
} from USGS Quad.

By interpolation: Area at El. 93.1 = 748 acres

STORAGE CAPACITIES

At spillway crest (El. 87.0) = 560 ac. x 12' avg. depth = 6,720 ac-ft.

At top of dam (El. 93.1) = 6,720 + (560 + 748)/2 x 6.1 = 10,710 ac-ft.

SIZE CLASSIFICATION

Hydraulic Height = 93.1 - 75.0 ≃ 18 ft.

Storage Capacity at top of dam = 10,710 ac-ft.

∴ Size is INTERMEDIATE

HAZARD CLASSIFICATION

Based on the dam failure analysis, failure of the dam would impact upon one house. Therefore the potential exists for the loss of a few lives and the Hazard Classification is SIGNIFICANT

TEST FLOOD DETERMINATION

For an Intermeadiate size dam with a Significant Hazard Classification, COE Guidelines give a test flood range of 1/2 PMF to a full PMF. (Probable Maximum Flood). Adopt 1/2 PMF for test flood.

The upstream watershed terrain is basically Flat & Coastal with numerous U/S lakes and ponds including St. George and Quantabacook Lakes. From COE Guideline curves for estimating PMF, 400 CSM is given for a D.A. of 110 sq. mi. having Flat & Coastal characteristics. Because of the numerous U/S ponds and lakes, use a PMF inflow rate of 250 CSM.

∴ 1/2 PMF inflow = 110 mi^2 x 250 CSM x 1/2 = 13,750 CFS

STAGE-DISCHARGE RELATIONSHIPS

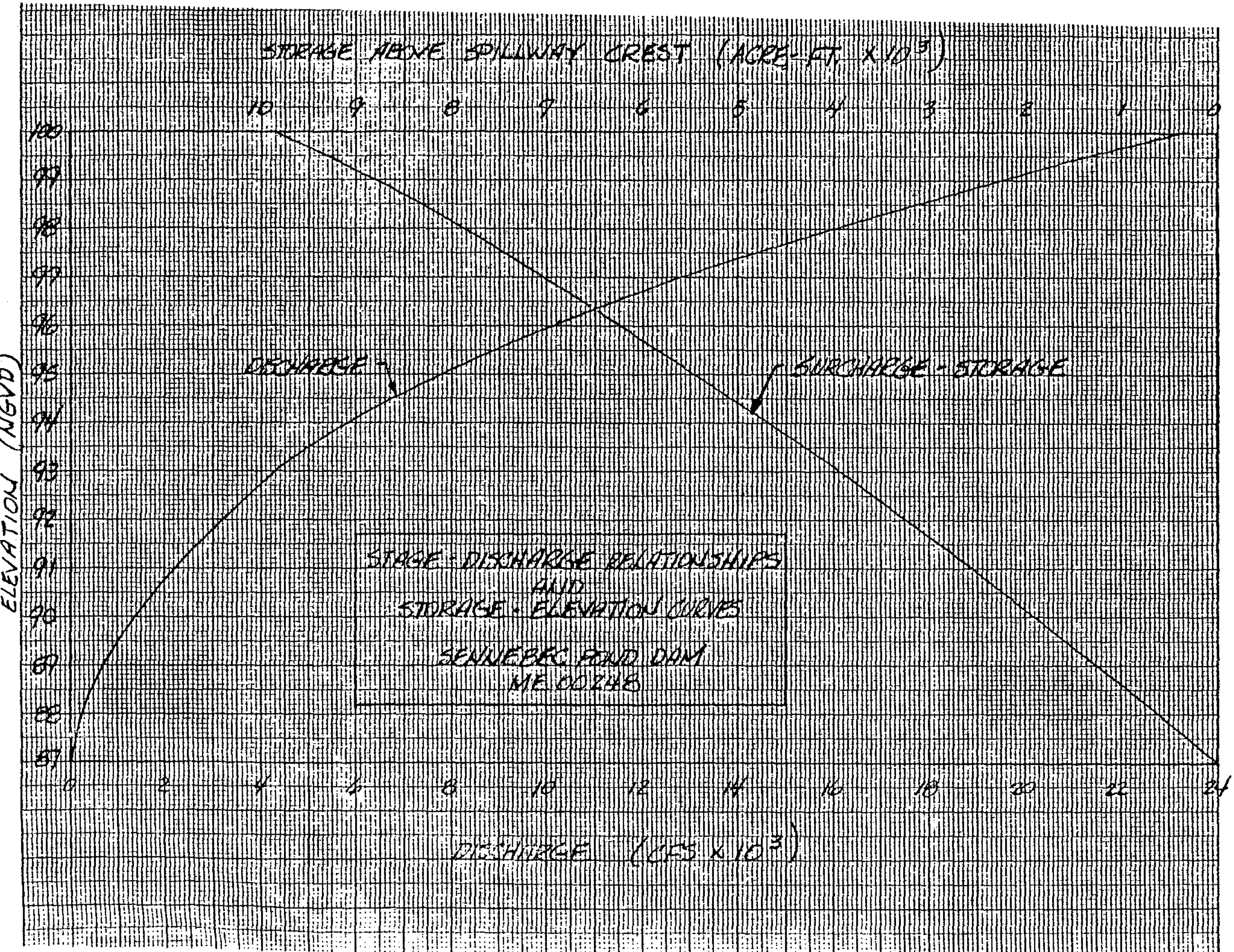
Spillway: $Q_S = C_S L_S H_S^{3/2}$ where "C_S" varies with H_S
L_S = 80 ft.
H_S = W.S. El. - 87.0

Dam Overtopping: $Q_D = C_D L_D H_D^{3/2}$ where "C_D" varies with H_D
L_D = 51 + 102 = 153 ft.
H_D = W.S. El. - 93.1

Gate Outlets:
The outlet works at right abutment are inoperable and sandbagged at u/s face
The three power canal head gates are also inoperable

∴ assume no flow through gated outlets

W.S. ELEV.	SPILLWAY		DAM OVERTOPPING		TOTAL (cfs)
	C_S	Q_S (cfs)	C_D	Q_D (cfs)	
87.0	-	0	-	-	0
89.0	3.1	700	-	-	700
91.0	3.45	2,210	-	-	2,210
93.1	3.65	4,400	-	0	4,400
94.0	3.7	5,480	2.65	350	5,830
96.0	3.7	7,990	2.8	2,120	10,110
98.0	3.7	10,800	3.15	5,230	16,030
100.0	3.7	13,870	3.4	9,430	23,300


STORAGE ABOVE SPILLWAY CREST (ACRE-FT X 10³)
10 9 8 7 6 5 4 3 2 1 0
100 99 98 97 96 95 94 93 92 91 90 89 88 87
ELEVATION (NGVD)
DISCHARGE
SURCHARGE - STORAGE
STAGE - DISCHARGE RELATIONSHIPS
AND
STORAGE - ELEVATION CURVES
SENNEBEC POND DAM
ME 00248
0 2 4 6 8 10 12 14 16 18 20 22 24
DISCHARGE (CFS X 10³)

SURCHARGE - STORAGE ROUTING

Test Flood Inflow, Q_{P_1} = 13,750 cfs

Surcharge Ht. to pass Q_{P_1} is El. 97.3

$STOR_1$ @ El. 97.3 = $\frac{7{,}250 \text{ ac-ft} \times 12 \text{ "/ft.}}{110 \text{ mi}^2 \times 640 \text{ ac./mi}^2}$ = 1.24" R.O.

$Q_{P_2} = Q_{P_1}(1 - STOR_1/9.5") = 13{,}750(1 - 1.24/9.5) = 11{,}960$ cfs

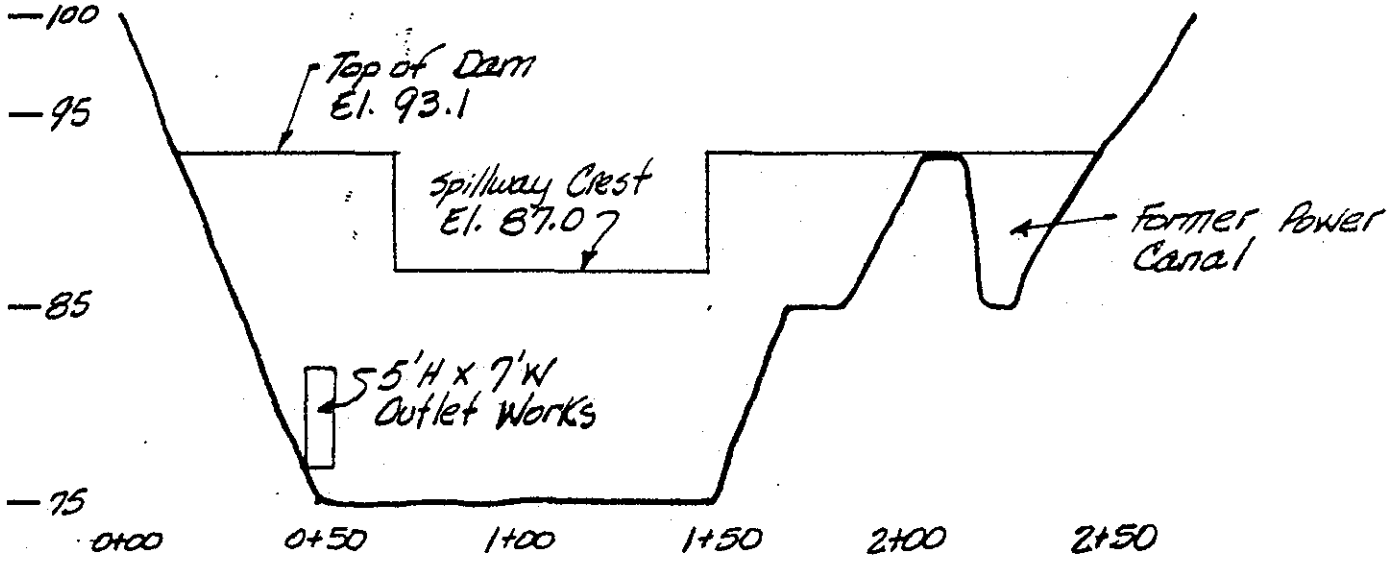
Surcharge Ht. to pass Q_{P_2} is El. 96.7

$STOR_2$ @ El. 96.7 = $6{,}800 \text{ ac-ft} \frac{\times 12}{110 \times 640}$ = 1.16" R.O.

$STOR_A = (1.16 + 1.24)/2 = 1.2"$

$Q_{P_3} = 13{,}750(1 - 1.2/9.5) \approx 12{,}000$ cfs @ El. 96.7

TAILWATER ANALYSIS



D/S CHANNEL X-SECT.
LOOKING U/S

Determine d/s channel stage-discharge relationship.

$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$ where avg. "n" = 0.05
$S = 0.025$

then $Q = 1.49/0.05 \times AR^{2/3} (.025)^{1/2} = 4.71 AR^{2/3}$

W.S. Elev.	Area ($ft.^2$)	R	Q (cfs)
75.0	0	-	0
77.0	208	1.91	1,510
79.0	432	3.66	4,830
81.0	672	5.30	9,620
82.0	798	6.08	12,520
82.5	863	6.46	14,100

By interpolation,

Pond at top of dam, El. 93.1

Q_s = 4,400 cfs
Tailwater elev. is ~ 78.7 << spillway crest elev.

Pond at Test Flood level, El. 96.7

$Q_{outflow}$ = 12,000 cfs
Tailwater elev. is ~ 81.8 << spillway crest elev.

OUTLET WORKS

Gated outlet, 5'H x 7'W, INV. El. 76.8

$Q = CA(2gh)^{1/2}$ where $C = 0.6$, $A = 5 \times 7 = 35$ ft.^{2}
h = W.S. $-$ (76.8 + 2.5)

Pond at El. 87.0 $Q = .6 \times 35 \times (64.4 \times 7.7)^{.5} = 470$ cfs
Pond at El. 93.1 $Q = .6 \times 35 \times (64.4 \times 13.8)^{.5} = 630$ cfs
Pond at El. 96.7 $Q = .6 \times 35 \times (64.4 \times 17.4)^{.5} = 700$ cfs

DAM FAILURE ANALYSIS

Spillway discharge prior to failure with pond level at top of dam

$$Q_s = 3.65 \times 80 \times (6.1)^{3/2} = 4{,}400 \text{ cfs}$$

Crest length of dam = 80 + 153 = 233 ft.
Approx. length at mid-height = 125 ft.

Assume length of failure section = 40% of mid-height length = 125 × .4 = 50 ft.

Then peak failure outflow = Q_{P_1}

$$Q_{P_1} = 8/27 \times 50 \times (32.2)^{1/2} (18)^{3/2} = 6{,}420 \text{ cfs}$$

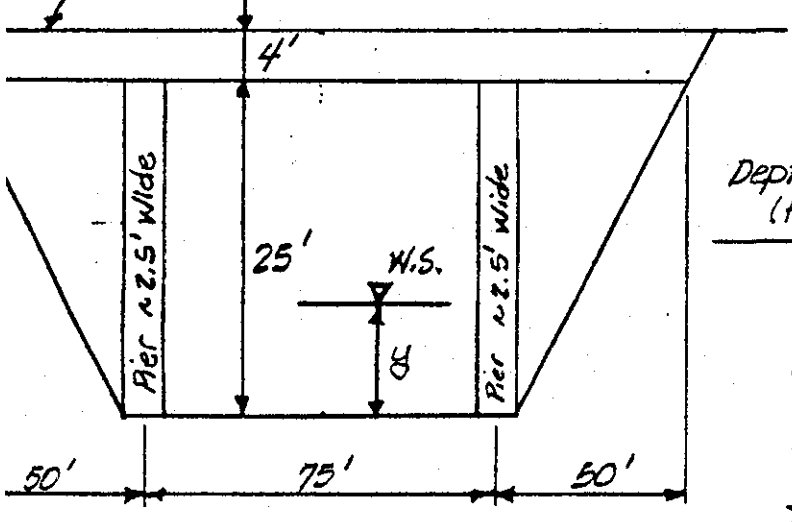
Discharge would also be occurring over about 30 ft. of spillway adding an additional flow of $4{,}400 \times 30/80 = 1{,}650$ cfs $= Q_s'$

Then combined discharge at failure

$$= Q_{P_1} + Q_s' = 6{,}420 + 1{,}650 = 8{,}070 \text{ cfs}$$

First D/S Reach: from dam to Route 17 & 131
Reach length ~ 6,000 ft.
Channel slope ~ 0.003
Channel "n" assumed to be 0.05 at Routes 17 & 131 bridge

No exist. development below elev. 100.0



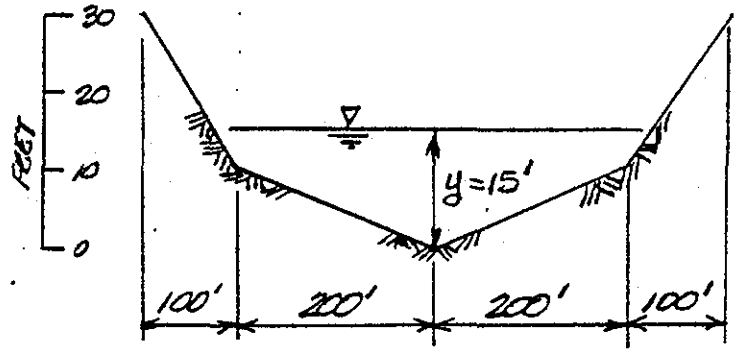
$$Q = \frac{1.49}{0.05} A R^{2/3} (.003)^{1/2} = 1.63 A R^{2/3}$$

Depth (y) (ft.)	Area ($A.^2$)	R	Q (cfs)
5	392	4.13	1,650
10	868	7.61	5,470
12	1057	8.68	7,280

Then for 8,070 cfs, depth ≃ 12.5 ft.

Reach No. 1 Outflow Routing for channel storage:

Q_{P_1} = 8,070 cfs
Stage @ Routes 17 & 131 = 12.5 ft. depth
Volume between dam and bridge = V_1 = 558 ac-ft.
assuming an avg. u/s depth of 15 ft. and the following channel configuration over the 6,000 ft. Reach Length:



At y = 15',
Area = [200 × 10 × 1/2 + 200 × 5 + 5 × 25 × 1/2] × 2
= 4,050 ft.²

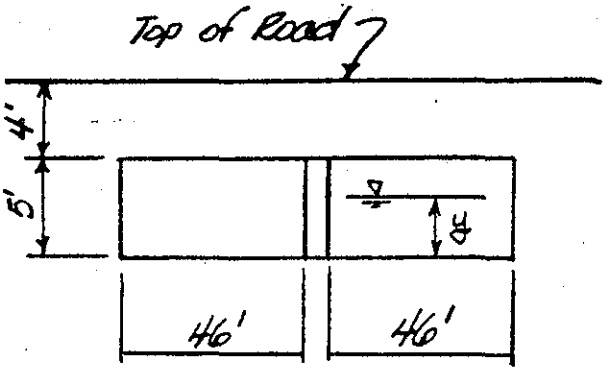
Volume = 4050 [1] × 6,000 L.F.
= 24,300,000 c.f.
or 558 ac-ft.

then Q_{P_2} trial = 8,070 (1 − 558/10,710) = 7,650 cfs

both depth and volume for 7,650 cfs are about the same as for Q_{P_1} & V_1, ∴ Q_{P_2} = 7,650 cfs

No existing development would be impacted at this depth of flow in Reach No. 1

Second D/S Reach: from Routes 17 & 131 to next d/s bridge
Reach length ~ 1400 ft.
Channel slope ~ 0.003
Channel "n" assumed to be 0.05 at bridge



Flow through and over bridge will be pressure and weir flow

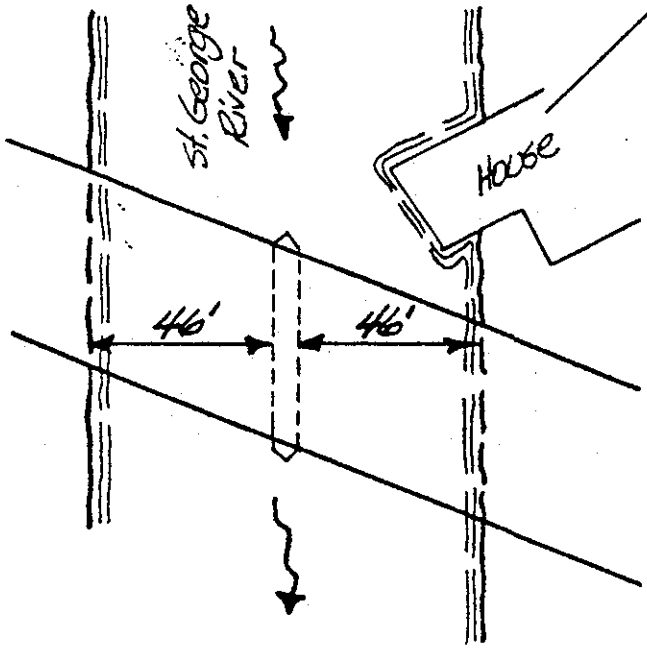
$Q_P = CA(2gh)^{1/2}$ where C = 0.85
A = 46 × 5 × 2 = 460 ft.²
h = y − 2.5'

$Q_W = CLH^{3/2}$ where C = 2.6
L = 150 ft.
H = y − 9'

Depth (y) (ft.)	h (ft.)	Q_P (cfs)	H (ft.)	Q_W (cfs)	TOTAL Q (cfs)
6	3.5	5,870	-	-	5,870
7	4.5	6,660	-	-	6,660
8	5.5	7,360	-	-	7,360
9	6.5	8,000	0	0	8,000
10	7.5	8,590	1	390	8980

Then dam failure flow of 7,650 cfs would surcharge the bridge opening to almost the top of road, say about 8.5 ft. above the channel invert.

There is an existing house immediately U/S of this bridge which extends out about 25 ft. into the channel as indicated by the sketch below:



The basement of this structure is founded on the stream bed with the first floor sill elev. about 2 to 3 ft. below the top of Road.

Failure of the Seamsbec Pond Dam would nearly overtop the road and impact on this structure, with the resulting potential for the loss of a few lives.

As no other structures where observed that would be impacted by a dam failure, the hazard potential is significant.

APPENDIX E - INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

NOT AVAILABLE AT THIS TIME

Sennebec Pond Dam, Union, Maine: phase I inspection report, National Dam Inspection Program. -- Waltham, Mass : U.S. Army Corps of Engineers, New England Division, 1981.
vii, [55] p. : ill., maps ; 28 cm. - (ME00248)
"April 1981"
1. Dams--Inspection--Maine--Sennebec Pond Dam. 2. Dam safety--Maine--Sennebec Pond Dam. 3. Sennebec Pond Dam (Me.)--Inspection. 4. Union (Me.)--Dams. 5. Saint George River watershed (Me.)--Dams. I. United States. Army. Corps of Engineers. New England Division. II. Series